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FIXATING DEVICE FOR ADJACENTLY ARRANGED BONES AND CONTACTING INSTRUMENT FOR THEM

[Fixiervorrichtung für nebeneinander angeordnete Knochen und Anlegeinstrument dafür]

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UNITED STATES PATENT AND TRADEMARK OFFICE
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The invention relates to a fixating device for adjacently /1* arranged bone plates with a first plate-shaped contact element, a shaft vertically projecting from its middle, and with a second plate-shaped contact element with a central opening through which the shaft passes, so that the second contact element along the shaft is displaceable in the direction towards the first contact element. Moreover, the invention relates to a contacting instrument for such a fixating device.

This kind of fixating device is used to fixate one bone plate in relation to another bone plate, for instance, in the area of the skull, to fit a cranial vault into an opening of the skull bone. The familiar approach is to bring such fixating devices with two mutually displaceable plate-shaped contact elements into the contact position by using a contacting instrument which holds the shaft with clamping jaws and by then shifting the second contact element on the shaft in the direction towards the first contact element with a implement (DE 29700269). However, when fixating the shaft with clamping jaws, it cannot be ruled out that the shaft will slide in relation to the clamping jaws, so that a secure contact of the fixating device may be put at risk. /2

It is the objective of the invention to configure a generic fixating device in such a way that it can safely be put into contact by means of a contacting instrument without any danger of slippage.

In accordance with the invention, with a fixating device of the type described at the beginning of the text, this objective is realized in that the shaft bears, at least, one projection protruding towards the

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*Number in the margin indicates pagination in the foreign text.

outside on the side of the second contact element which faces away from the first contact element. This projection acts as a stop for a contacting instrument which, on the one hand, grips between this projection and, on the other hand, grips into the second contact element with implements and displaces the second contact element in the direction towards the first contact element by enlarging the distance of the implements. The secure contact of the first implement at the projection ensures that this first implement assumes a defined position in relation to the shaft in axial direction, which can be safely maintained during the contacting process. A sliding or slippage, as it occurs with familiar contacting instruments, is thereby ruled out.

The projection can generally be formed by a thickened area, but it is advantageous if the projection is configured in a step shape.

In particular, the projection is located near the free end of /3 the shaft.

In a first preferred configuration, the provision is that the projection is configured in one piece with the shaft. For instance, the shaft may be deformed to form the projection; in particular, the shaft is pressed flat on the end side.

In another configuration example, the provision is that the projection is formed by a stop element which is set on the shaft and held on the shaft, so that it cannot be displaced in axial direction.

It is preferably located in the proximity of the free end; specifically, the stop element may be set directly on the free end of the shaft and thus closes off the shaft.

The stop element may, for instance, be screwed or clamped on the shaft.

In a preferred configuration, the stop element is configured in the shape of a ring.

An especially secure fixation of such a contact element results if, in accordance with a preferred configuration of the invention, it dips into a circumferential groove of the shaft, especially if the height of the circumferential groove is the same as the height of the stop element.

This can, for instance, be achieved in that, in its undeformed /4
state, the stop element exhibits a central opening, the inside diameter of which is greater than the outside diameter of the shaft, and in that the stop element is deformed in such a way that, at least, in some areas, the opening will exhibit an inside diameter which is smaller than the outside diameter of the shaft. Thus, in other words, a ring-shaped stop element is deformed by deforming it into the circumferential groove.

In another preferred configuration, the provision may be that the projection is formed by, at least, one circumferential groove in the shaft.

In particular, several circumferential grooves may be arranged in the shaft spaced out in relation to one another.

In a preferred configuration, the circumferential grooves exhibit a sawtooth-shaped cross-section with a top edge which extends transversely in relation to the shaft's longitudinal direction.

Moreover, it is the objective of the invention to create a generic contacting instrument for such fixating devices with which a secure contacting of the fixating device can be realized.

With a contacting instrument with two implements that can be put at a distance to one another, of which the first one can be put into /5 contact on the side of the second contact element which faces away from the first contact element and the second one can be fixated on the shaft, this objective can be realized in accordance with the invention in that the second implement bears a contact head with two support elements that laterally surround the shaft, which can be put into contact at the projection of the shaft.

With a first preferred configuration, the provision is that the support elements are two brackets extending in parallel to one another, which enclose a gap between them, the width of which, at least, corresponds with the outside diameter of the shaft, but is smaller than the diameter of the projection. As a result, the contact head with the parallel-extending brackets can be guided towards the shaft on the side; the brackets can then be put in contact on the projection by axially displacing the contact head.

It is advantageous if the second implement exhibits a recess into which the projection dips when the implement is put in contact with the projection and if it is thereby secured against a displacement transversely to the longitudinal direction of the shaft.

In another other configuration, the support elements may be clamping jaws which can be put in contact on the shaft on the side. Their slippage is prevented through their contact against the projection.

The provision may also be that the clamping jaws bear several projections which are arranged at a distance to one another, which, /6 respectively, grip behind a projection on the shaft.

In particular, these projections may be formed on the clamping jaws by teeth with a sawtooth-shaped profile.

The following description of preferred configurations of the invention serves to further explain it in connection with the drawings. Shown are:

Figure 1: a longitudinal sectional view through a fixating device for bone plates with the essential components of a contacting instrument (dash-dotted);

Figure 2: an enlarged longitudinal sectional view of area A in Fig. 1;

Figure 3: a sectional view along line 3-3 in Fig. 2;

Figure 4: a view similar to Figure 3 with a modified configuration example of a stop element;

Figure 5: a view similar to Figure 3 with a modified configuration of a stop element;

Figure 6: an enlarged detailed view of the free end of /7 the shaft of a fixating device with a screwed-on stop element;

Figure 7: a view similar to Fig. 6 with a staked-on stop element;

Figure 8: a view similar to Figure 6 with a flattened shaft end to form a stop element;

Figure 9: a view similar to Fig. 8 with an additional passage opening in the deformed end area;

Figure 10: a view of the shaft end in the direction of the arrow B in Fig. 9;

Figure 11: a view of another configuration example of a shaft end with circumferential grooves, and,

Figure 12: a shaft end with sawtooth-shaped circumferential grooves and a contacting implement in the shape of a toothed clamping jaw.

The fixating device (1) shown in the drawings serves to fixate two bone plates in a defined adjacent position in relation to one /8 another, for instance, a loose bone plate (2), which is to be set into an opening (3) of the skull bone (4). For this purpose, the fixating device (1) exhibits a first plate-shaped contact element (5) with a central opening (6) through which an oblong thin shaft (7) is stuck, which is held so that it is undisplaceable in relation to the contact element (5), for instance, through agglutination, heat-sealing, or form-fitting.

The outside diameter of the shaft (7) is so small that the shaft (7) fits through the narrow gap (8) between the bone plate (2) and the skull bone (4); the shaft (7) may be configured as a thin rod or high-strength wire.

In the area connecting with the first stop element, the shaft (7) exhibits a great number of circumferential ribs (9) extending in parallel to one another; moreover, from the free end (10) of the shaft (7), a second plate-shaped contact element (11) is pushed on the shaft (7). This second contact element (11) also exhibits a central opening (12) through which the shaft (7) is passed and, from this opening (10), radial notches start

out which are not seen in the drawings, which form lobular sections in the plate-shaped contact element (11) adjacent to the opening (12), which, when the contact element (11) is pushed on, are bent against the direction in which it is pushed on, and which rest against the shaft (7) with their edges. As a result, the contact element (11) can only be displaced on the shaft in one direction and, more specifically, in the direction /9 towards the first contact element (5); in a backwards movement, the edges of these lobes clamp together and prevent a backshifting. This particularly is supported in that, in the area of the circumferential ribs (9), the edges of the lobes dip into the circumferential grooves which are formed between the circumferential ribs (9) and thereby grip behind the circumferential ribs (9).

These circumferential ribs (9) extend over a partial area of the shaft (7) which directly connects to the first contact element (5) and covers a little more than one half of the shaft length. Connecting to the section equipped with circumferential ribs (9), a holding section (13) is provided which, from top to bottom, exhibits a circumferential rib (14), an in-between section (15), and a conically expanded transitional section (16). In this holding section (13), the second contact element (11) is held before the fixating device (1) is actually placed into contact. For this purpose, the contact element (11) is pushed on the shaft (7) from the free end (10) until it has been pushed over the circumferential rib (14) and is located in the in-between section (15). A backshifting of the circumferential rib (14) is not possible; nor can the contact element (11) be pushed over the conically expanded transitional section (16)

without a more substantial displacing force, i.e., the contact element (11) is normally located in the in-between section (15). To put it into contact, a more substantial force must be exerted on the contact element (11), so that it is pushed over the conically expanded transitional section (16), whereas then the lobes of the second contact element (11) are /10 deformed against the displacement direction in the manner described and slide over the circumferential ribs (9) during the further displacement process.

In the configuration example that is shown in Figs. 1 to 5, the shaft (7) between the free end (10) and the holding section (13) is configured cylindrically and bears a circumferential groove (17) in the proximity of the free end (10), which is designed as a recess, and therefore ends in steps on both sides. A ring-shaped stop element (18) is pushed over the shaft (7), the height of which corresponds with the width of the circumferential groove (17). The ring-shaped stop element (18) exhibits a central opening (19), the inside diameter of which is essentially the same as the outside diameter of the shaft (7), so that the stop element (18) can easily be pushed over the shaft. At the height of the circumferential groove (17), the ring-shaped stop element (18) is radially deformed towards the inside, for instance, in an oval shape (Fig. 3), a lens-shaped form (Fig. 4), or a nearly square shape (Fig. 5), so that the stop element (18), at least partially, is deformed into the circumferential groove (17). Such a deformation can be managed with an appropriate plier-type implement and results in the stop element (18) being fixated on the shaft (17) in axial direction by gripping into the

circumferential groove (17). With its bottom side (20), it forms a projection against which a implement of a contacting instrument can rest.

Such a contacting instrument may, for instance, be configured in /11 the shape of pliers with two mutually pivoting branches (21 and 22) which are only suggested dash-dotted in Fig. 1. Each of these branches (21 and 22) is configured as a contact head (23 or 24) on its free end; both contact heads are suitable to place the contacting instrument into a contact with the bottom side (20) of the stop element (18), on the one hand, and with the top side of the second contact element (11), on the other hand. When the two branches (21 and 22) are opened, the contact heads (23 and 24) are distanced from one another. Because the contact head (23) is fixated on the stop element (18) in axial direction, this results in a displacement of the second stop element (11) into the contact position on the bone plate (2) on the skull bone (4); in Fig. 1, this contact position is shown dashed.

Both contact heads (23 and 24) are essentially configured U-shaped, i.e., they exhibit two side-by-side arms with an in-between gap. To put the contacting instrument into a contact, the latter is laterally guided to the shaft (7) in such a way that it enters the gap between the two arms. Moreover, on its top side, the contact head (23) exhibits a recess (25) into which it can dip when the contact head (23) is placed into a contact at the stop element (18), so that it is secured against a displacement transversely to the longitudinal axis of the shaft (7), specifically meaning against the contact head (23) sliding off the fixating device (1).

In the configuration example of Figs. 1 to 5, the stop element /12
(18) is realized through a ring-shaped, separate component which is pushed on the shaft (7) and axially fixated on it there.

These types of stop elements can also be realized in a different manner.

In the configuration example of Fig. 6, such a stop element is realized through a cap (27) which is screwed on the free end (10) of the shaft (7); in the configuration example of Fig. 7, it is realized through a similar cap (28) which is stuck on the free end (10) of the shaft (7) and is fixated there in an appropriate manner, for instance, by means of agglutination, deformation, soldering, etc.

In the configuration examples of Figs. 8 to 10, no separate stop element is pushed on the shaft (7), instead the shaft (7) itself is configured through an appropriate deformation in such a way that it forms a laterally protruding projection on which the contact head (23) rests.

In the configuration example of Fig. 8, the free end (10) is pressed flat and laterally protrudes over the circumference of the shaft (7); in the configuration example of Figs. 9 and 10, such a projection is realized in a similar manner, however, in this area, a passage opening (29) is additionally provided, which for instance, may be used to /13
remove the shaft (7) from the area of the surgery after the fixating device has been put in place.

In the configuration example of Fig. 11, no laterally protruding projections are provided over the shaft's circumference; instead, several parallel circumferential grooves (30) are worked into the shaft (7).

With their side walls, these circumferential grooves (30) form appropriate projections against which a contacting instrument can be placed, preferably, in that the contacting instrument grips into the circumferential grooves (30) with its own projections. Thus, the side walls of the circumferential grooves (30) form appropriate projections for such a contacting instrument.

Figure 12 depicts a configuration example in which the circumferential grooves (30) exhibit a sawtooth-shaped profile; a contacting instrument in the form of a lateral clamping jaw (31) is equipped with a number of teeth (32) which can grip into the circumferential grooves (30), so that a positive form-fit is produced between the clamping jaws (31) and the shaft (7) in axial direction. Figure 12 only shows one clamping jaw (31); usually, the clamping jaws are used in pairs and grip the shaft (7) between them.

In all cases, by providing projections and recesses, the axial securing of the shaft of the fixating device (1) against any displacement is guaranteed, so that no danger of slippage exists /14 during the contacting process. Therefore, any movement of the implements of the contacting instrument is securely transferred to the second contact element (11), which is therefore displaced accurately according to the movement of the contacting instrument.

Protection Claims /15

1. Fixating device for adjacently arranged bone plates with a first plate-shaped contact element, a shaft vertically projecting from its middle, and with a second plate-shaped contact element with a central

opening through which the shaft passes, so that the second contact element along the shaft is displaceable in the direction towards the first contact element, characterized in that the shaft (7) bears, at least, one projection (18, 20; 27; 28; 10; 30) projecting to the outside in the section of the second contact element (11) which faces away from the first contact element (5).

2. Device in accordance with Claim 1, characterized in that the projection is configured in the shape of steps.

3. Device in accordance with Claim 1 or 2, characterized in that the projection is provided in the proximity of the free end (10) of the shaft (7).

4. Device in accordance with any of the previous Claims, /16 characterized in that the projection (10; 30) is configured in one piece with the shaft (7).

5. Device in accordance with Claim 4, characterized in that the shaft (7) is deformed to form the projection (10).

6. Device in accordance with Claim 5, characterized in that the shaft (7) is pressed flat on the end side to form the projection (10).

7. Device in accordance with any of the Claims 1 to 3, characterized in that the projection is formed by a stop element (18; 27; 28) which is set on the shaft (7) and held on the shaft (7), so that it cannot be displaced in axial direction.

8. Device in accordance with Claim 7, characterized in that the stop element (27; 28) is set on the free end (10) of the shaft (7).

9. Device in accordance with Claim 7 or 8, characterized in that the stop element (27) is screwed on the shaft (7).

10. Device in accordance with Claim 7 or 8, characterized in /17 that the stop element (28) is clamped on the shaft (7).

11. Device in accordance with any of the Claims 7 to 10, characterized in that the stop element (18) is configured ring-shaped.

12. Device in accordance with Claim 11, characterized in that the stop element (18) dips into a circumferential groove (17) of the shaft (7).

13. Device in accordance with Claim 12, characterized in that the height of the circumferential groove (17) is the same as the height of the stop element (18).

14. Device in accordance with Claim 12 or 13, characterized in that the stop element (18) exhibits a central opening (19) in its undeformed state, the inside diameter of which is larger than the outside diameter of the shaft (7), and that the stop element (18) is deformed in such a way that the opening (19), at least in some areas, exhibits an inside diameter which is smaller than the outside diameter of the shaft (7).

15. Device in accordance with any of the Claims 1 to 4, /18 characterized in that the projection is formed by at least one circumferential groove (30) in the shaft (7).

16. Device in accordance with Claim 15, characterized in that several shafts (30) are spaced at a distance to one another in the shaft (7).

17. Device in accordance with Claim 16, characterized in that the circumferential grooves (30) exhibit a sawtooth-shaped cross-section with a top edge which extends transversely in relation to the longitudinal direction of the shaft (7).

18. Contacting instrument for the fixating device of Claims 1 to 17 with two implements which can be distanced from one another, of which the first one can be put into contact on the side of the second contact element which faces away from the first contact element and the second one can be fixated on the shaft, characterized in that the second implement bears a contact head (23) with two support elements which laterally surround the shaft (7), which can be placed into contact on the projection (18; 27; 28; 30).

19. Instrument in accordance with Claim 18, characterized in /19 that the support elements are brackets which extend in parallel to one another, which enclose a gap between them, the width of which at least corresponds with the outside diameter of the shaft (7), but is smaller than the diameter of the projection (18; 27; 28; 10; 30).

20. Instrument in accordance with any of the Claims 18 or 19, characterized in that the second implement (23) exhibits a recess (25) into which the projection dips when the implement is placed into contact on the projection (18; 27; 28; 30) and is thereby secured against a displacement transversely in relation to the shaft's (7) longitudinal direction.

21. Instrument in accordance with Claim 18, characterized in that the brackets are clamping jaws (31) which can be placed into a lateral contact with the shaft (7).

22. Instrument in accordance with Claim 21, characterized in that the clamping jaws (31) bear several projections (32) which are arranged at a distance to one another, which respectively grip behind a projection (30) on the shaft.

23. Instrument in accordance with Claim 22, characterized in /20 that the projections on the clamping jaws (31) are formed by teeth (32) with a sawtooth-shaped profile.

FIG.1

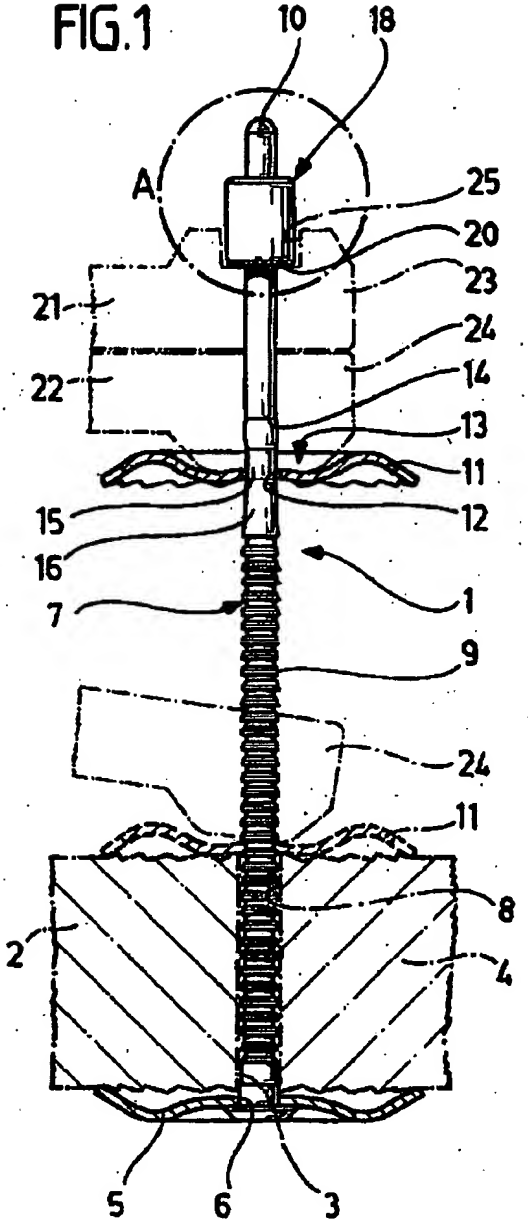

FIG.2

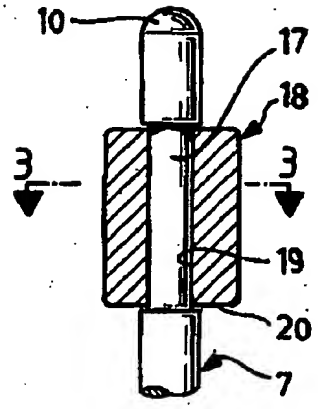

FIG.3

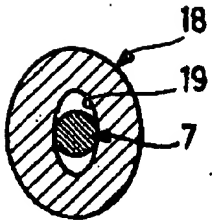

FIG.4

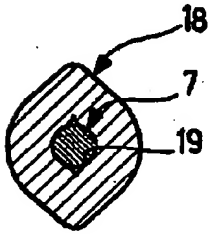

FIG.5

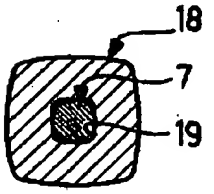

FIG.6

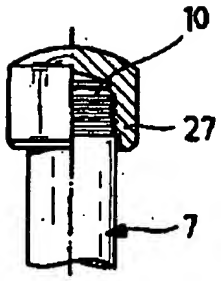

FIG.7

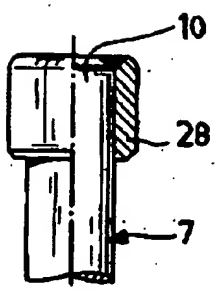

FIG.8

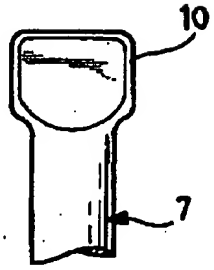

FIG.9

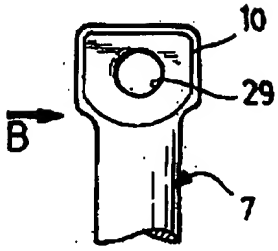

FIG.10

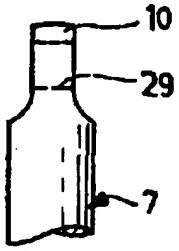

FIG.11

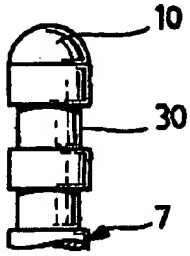

FIG.12